# WATER QUALITY MEMORANDUM

Utah Coal Regulatory Program

January 10, 2008

OK

TO: Internal File

THRU: Pamela Grubaugh-Littig, Permit Supervisor pgl

FROM: Dana Dean, P.E., Senior Reclamation Hydrologist

RE: 2007 First Quarter Water Monitoring, Genwal Resources, Inc., Crandall Canyon Mine, C/015/0032-WQ07-1 Task #2731

The Crandall Canyon Mine was conducting continuous miner retreat mining in barrier pillars along the mains during the second quarter of 2007. Water monitoring requirements can be found in Section 7.31.21, and 7.31.22 of the MRP, especially Tables 7-4, 7-5, 7-8, 7-9, and 7-10.

**1. Was data submitted for all of the MRP required sites?** YES ☒ NO ☐

***Springs***

*The MRP requires the Permittee to monitor 24 springs each quarter. Some require full laboratory analysis according to Table 7-4, while others simply require field measurements.*

The Permittee submitted all required samples for the spring sites.

***Streams***

*The MRP requires the Permittee to monitor12 streams each quarter. Some require full laboratory analysis according to Table 7-8, while others simply require field measurements.*

The Permittee submitted all required samples for the stream sites.

***Wells***

*The MRP requires the Permittee to monitor 7 wells during the second quarter. All require full laboratory analysis according to Table 7-4.*

The Permittee submitted all required samples for the wells. Two were dry, and five were in-mine wells located in now inaccessible areas of the mine.

***UPDES***

*The UPDES Permit/MRP require monthly monitoring of 2 outfalls: 001,sed. pond discharge, and 002, mine water discharge.*

The Permittee submitted all required samples for the UPDES sites. Outfall 001 reported no flow.

**2. Were all required parameters reported for each site?** YES ☒ NO ☐

**3. Were any irregularities found in the data?** YES ☒ NO ☐

Several parameters fell outside of two standard deviations from the mean encountered at the respective sites. They were:

| Site | Parameter | Value | Standard Deviations from Mean | Mean |
|---|---|---|---|---|
| BCF | Carbonate as $CaCO_3$ | 24 mg/L | 3.54 | 10.20 mg/L |
| BCF | Cation/Anion Balance | -1.57 % | 2.21 | 1.51 % |
| LOF-1 | Cation/Anion Balance | -5.32 % | 2.35 | 1.89 % |
| Section 4 Creek | Total Suspended Solids | 111 mg/L | 2.11 | 37.13 mg/L |
| Section 4 Creek | Cation/Anion Balance | -4.386 % | 2.07 | 1.45 % |
| Section 4 Creek | Dissolved Magnesium | 63.21 mg/L | 2.14 | 71.02 mg/L |
| Section 4 Creek | Total Hardness | 427.148 mg/L | 2.13 | 475.41 mg/L |
| UPF-1 | Oil and Grease | 9 mg/L | 3.09 | 2.15 mg/L |
| SP-79 | Bicarbonate as $CaCO_3$ | 306 mg/L | 2.26 | 336.71 mg/L |
| UT-0024368-002 – Feb 6 | Specific Conductivity | 940 µmhos/cm | 2.32 | 755.46 µmhos/cm |
| UT-0024368-002 – Mar 7 | Specific Conductivity | 960 µmhos/cm | 2.57 | 755.46 µmhos/cm |

Bicarbonate has a weak downward trend at SP-79 ($R^2 = 0.4391$). There are only 6 samples in the population, and this, the lowest recorded concentration, is only 43 mg/L less than the highest concentration of 349 mg/L.

There is no trend in Carbonate at BCF ($R^2 = 0.029$). There are only 10 samples in the population, and the spread, is only 25 mg/L.

This is the first quarter that the cation/anion balance has been reported as negative or positive, instead of absolute value. At BCF and Section 4 Creek it is it is within the expected range (<5%), but as mentioned below, at LOF-1 it is outside of the expected value.

Dissolved magnesium has a weak downward trend at Section 4 Creek ($R^2 = 0.321$). There are only 7 samples in the population, and this, the lowest recorded concentration, is only 13 mg/L less than the highest concentration of 76 mg/L.

Oil and grease has only been detected at UPF-1 in 11 of 68 samples. This is an unusual reading, which will most likely not repeat in subsequent quarters. In any case, UPF-1 is located above the location of all the Permittee's surface activities.

There is a weak upward trend in the specific conductivity at Outfall 002 ($R^2 = 0.321$), with no real correlation to flow. There is no standard for specific conductivity, but it is closely related to total dissolved solids (TDS). The total dissolved solids concentration at Outfall 002 has no trend and is within the expected range.

The total hardness at Section 4 has a weak downward trend ($R^2 = 0.2009$). There are only 7 samples in the population, and all readings have fallen into the very hard range (>300 mg/l).

There is a fairly strong upward trend in total suspended solids at Section 4 Creek ($R^2 = 0.5112$). There are only 7 samples in the population. Additionally, the Permittee's hydrologic consultant notes that "...that monitoring site is located on the steep hillside immediately above Huntington Creek. There is a lot of soft, dark, organic-rich sediment in the channel substrate at that location, and it's difficult not to stir it all up when I'm mucking about setting my pipe for the flow measurement. It is particularly difficult when the ground around the little brook is all wet and muddy from the snowmelt as it was on that day. I checked my field notes and I did not note anything out of the ordinary upstream between the monitoring point and spring SP-79 on that monitoring event."

Many routine reliability checks fell outside of standard values:

| Site | Reliability Check | Value Should Be... | Value is... |
|---|---|---|---|
| BCF | Conductivity/Cations | >90 & < 110 | 87 |
| BCF | K/(Na + K) | < 20% | 50% |
| BCF | Mg/(Ca + Mg) | < 40 % | 52% |
| BCF | Na/(Na + Cl) | > 50% | 25% |
| Horse Canyon Creek | Conductivity/Cations | >90 & < 110 | 85 |
| Horse Canyon Creek | K/(Na + K) | < 20% | 42% |
| Horse Canyon Creek | Mg/(Ca + Mg) | < 40 % | 49% |
| Horse Canyon Creek | Na/(Na + Cl) | > 50% | 27% |
| Little Bear Creek | Conductivity/Cations | >90 & < 110 | 83 |
| Little Bear Creek | K/(Na + K) | < 20% | 42% |
| Little Bear Creek | Mg/(Ca + Mg) | < 40 % | 51% |
| Little Bear Creek | Na/(Na + Cl) | > 50% | 20% |
| LOF-1 | Cation/Anion Balance | < 5% | 5.34% |
| LOF-1 | Conductivity/Cations | >90 & < 110 | 85 |
| LOF-1 | K/(Na + K) | < 20% | 40% |

| | | | |
|---|---|---|---|
| LOF-1 | Mg/(Ca + Mg) | < 40 % | 51% |
| LOF-1 | Na/(Na + Cl) | > 50% | 32% |
| Section 4 Creek | Conductivity/Cations | >90 & < 110 | 85 |
| Section 4 Creek | K/(Na + K) | < 20% | 44% |
| Section 4 Creek | Mg/(Ca + Mg) | < 40 % | 61% |
| Section 4 Creek | Na/(Na + Cl) | > 50% | 20% |
| UPF-1 | Cation/Anion Balance | < 5% | 5.33% |
| UPF-1 | Conductivity/Cations | >90 & < 110 | 82 |
| UPF-1 | K/(Na + K) | < 20% | 55% |
| UPF-1 | Mg/(Ca + Mg) | < 40 % | 45% |
| UPF-1 | Na/(Na + Cl) | > 50% | 33% |
| Little Bear Spring | K/(Na + K) | < 20% | 43% |
| Little Bear Spring | Mg/(Ca + Mg) | < 40 % | 48% |
| Little Bear Spring | Na/(Na + Cl) | > 50% | 33% |
| SP-36 | Conductivity/Cations | >90 & < 110 | 89 |
| SP-36 | K/(Na + K) | < 20% | 40% |
| SP-36 | Mg/(Ca + Mg) | < 40 % | 56% |
| SP-36 | Na/(Na + Cl) | > 50% | 19% |
| SP-79 | Conductivity/Cations | >90 & < 110 | 87 |
| SP-79 | K/(Na + K) | < 20% | 49% |
| SP-79 | Mg/(Ca + Mg) | < 40 % | 62% |
| SP-79 | Na/(Na + Cl) | > 50% | 19% |

These inconsistencies do not necessarily mean that a sample is wrong, but it does indicate that something is unusual. An analysis and explanation of the inconsistencies by the Permittee would help to increase the Division's confidence in the samples. The Permittee should work with the lab to make sure that samples pass all quality checks so that the reliability of the samples does not come into question. The Permittee can learn more about these reliability checks and some of the geological and other factors that could influence them by reading Chapter 4 of *Water Quality Data: Analysis and Interpretation* by Arthur W. Hounslow.

**4. On what date does the MRP require a five-year re-sampling of baseline water data.**

Page 7-33 of the MRP states that groundwater samples collected during the low flow period every 5 years will be analyzed for baseline parameters.

Page 7-35 of the MRP states that surface water samples collected during the low flow period every 5 years will be analyzed for baseline parameters.

Therefore, the next re-sampling of baseline parameters is required by the fourth quarter of 2010.

**5. Based on your review, what further actions, if any, do you recommend?**

No further actions are necessary at this time.

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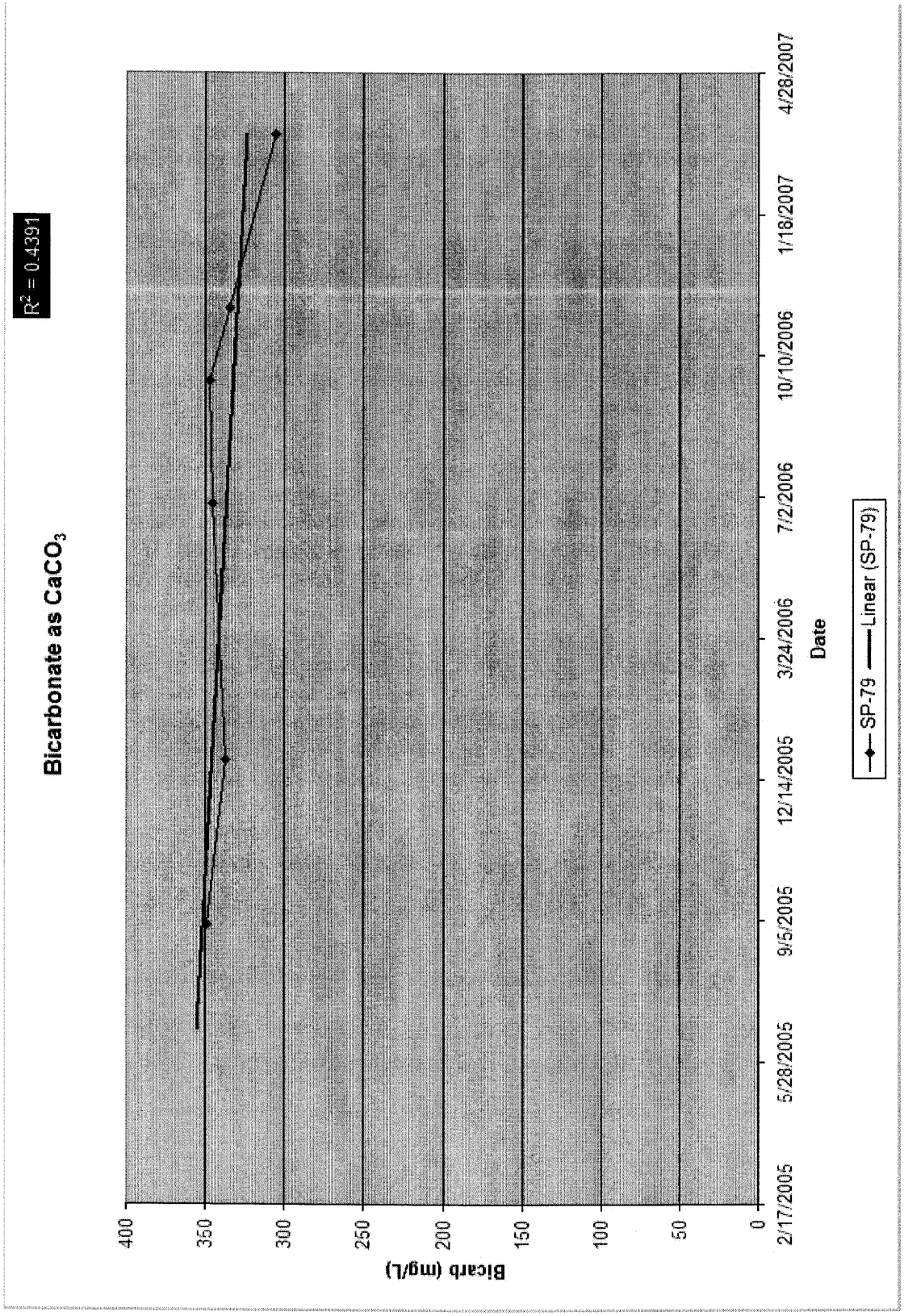
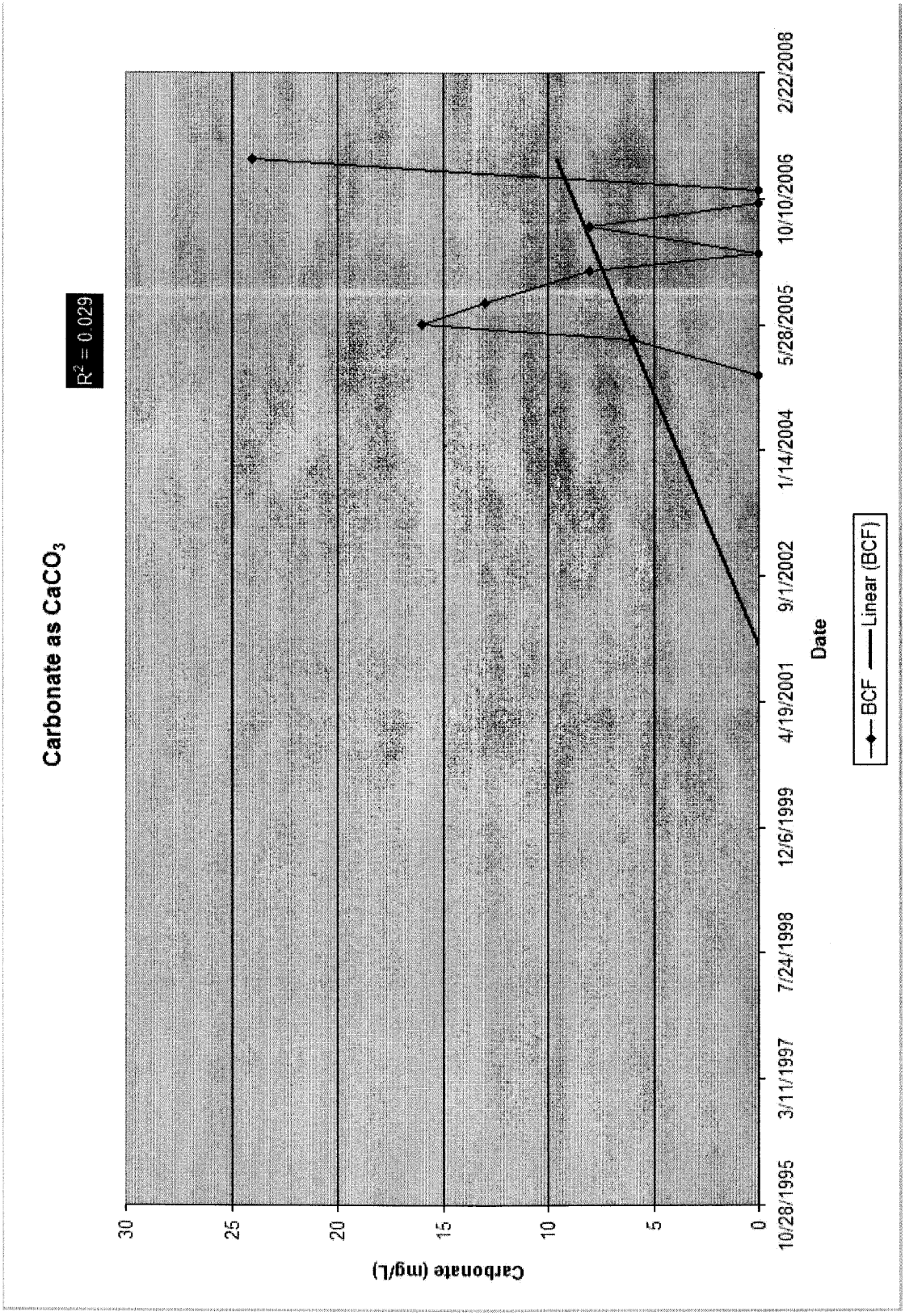
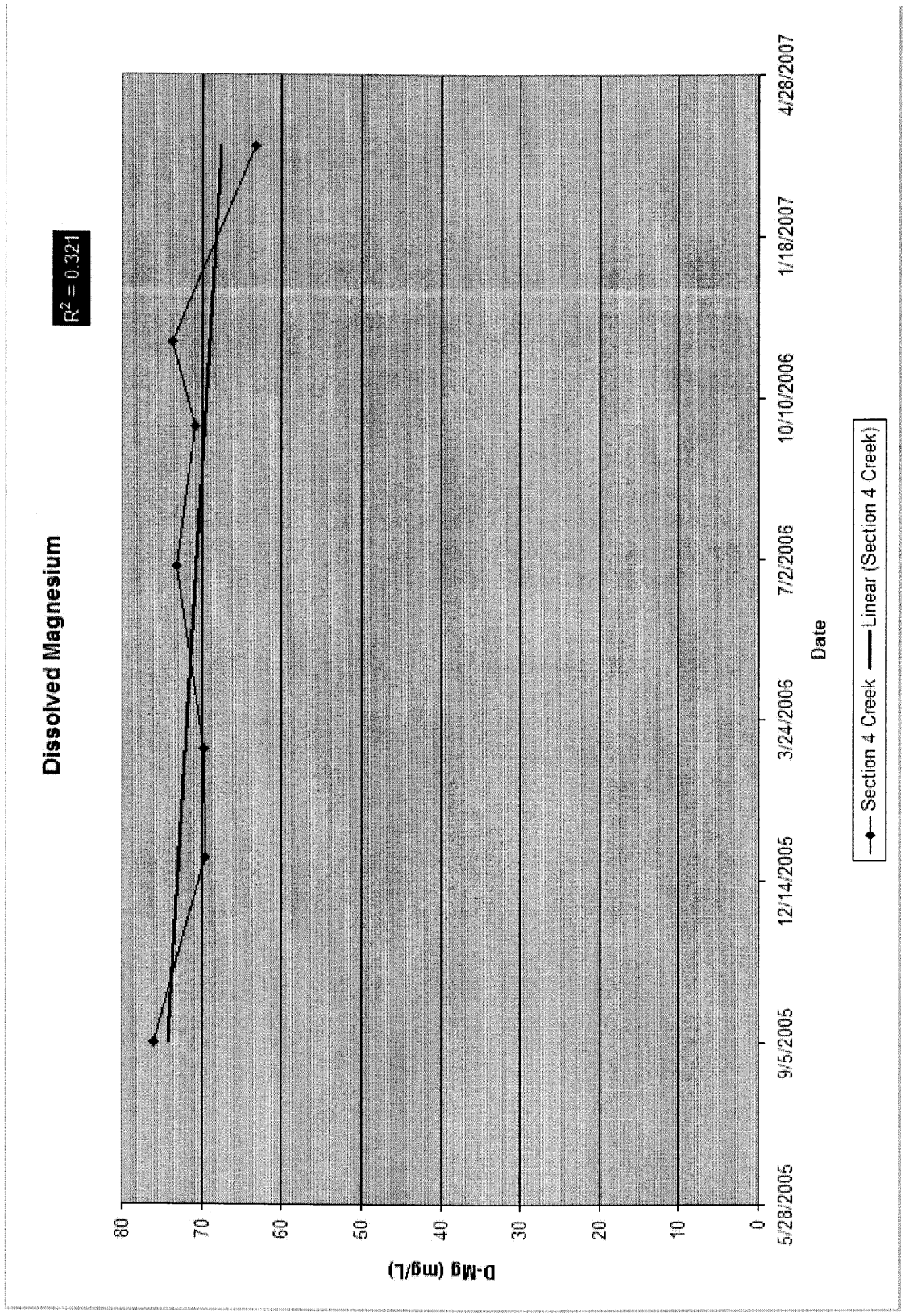
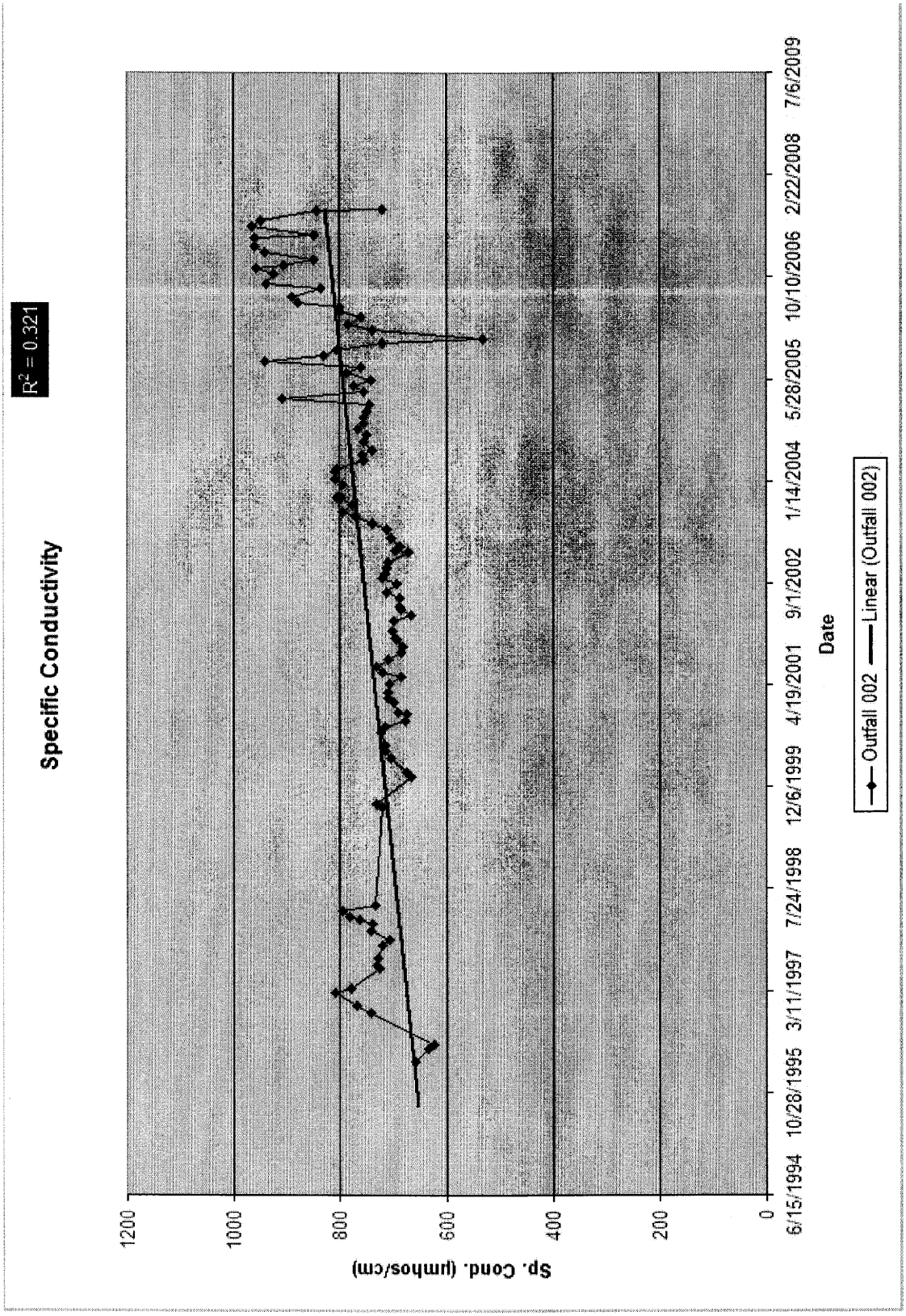
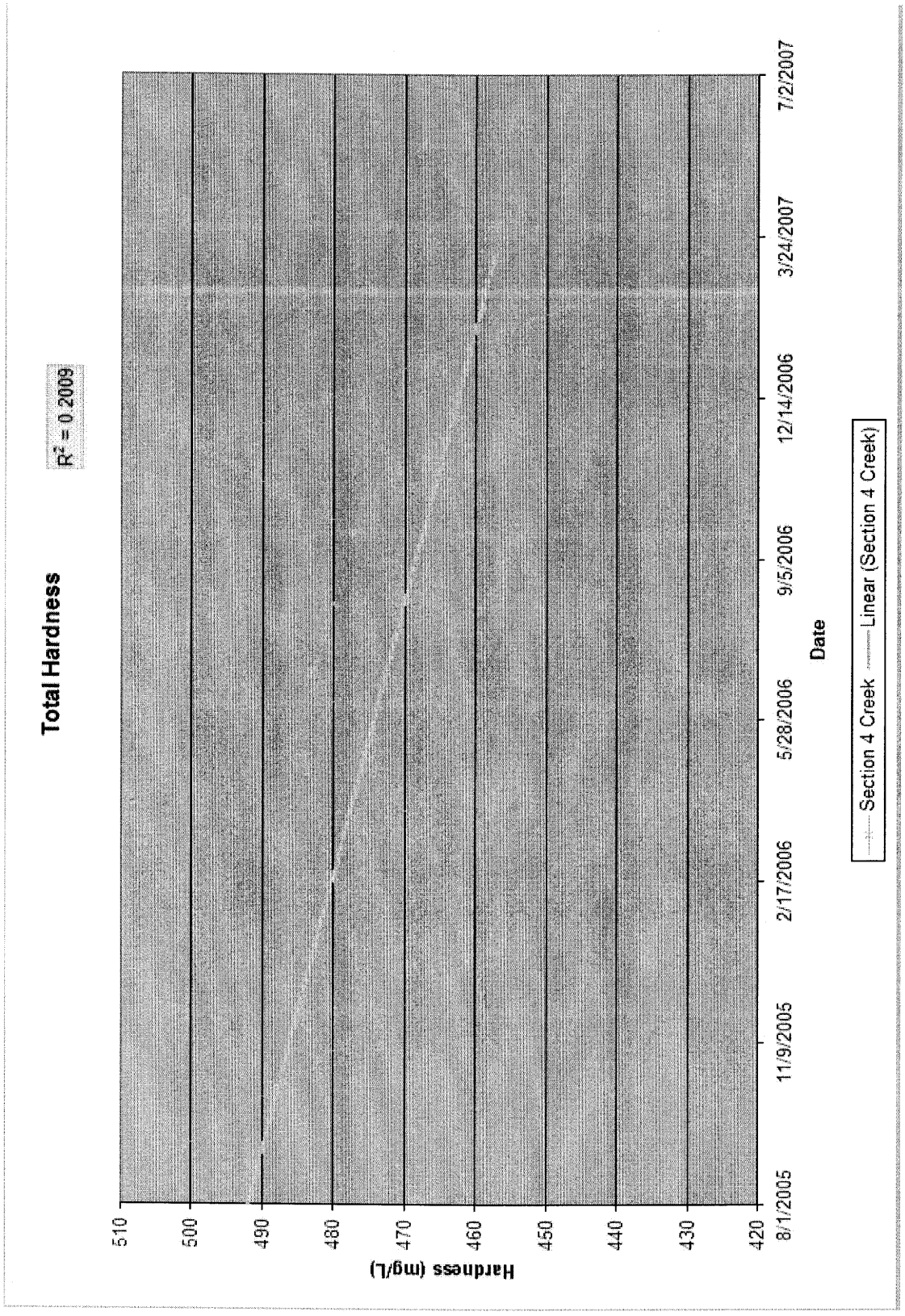
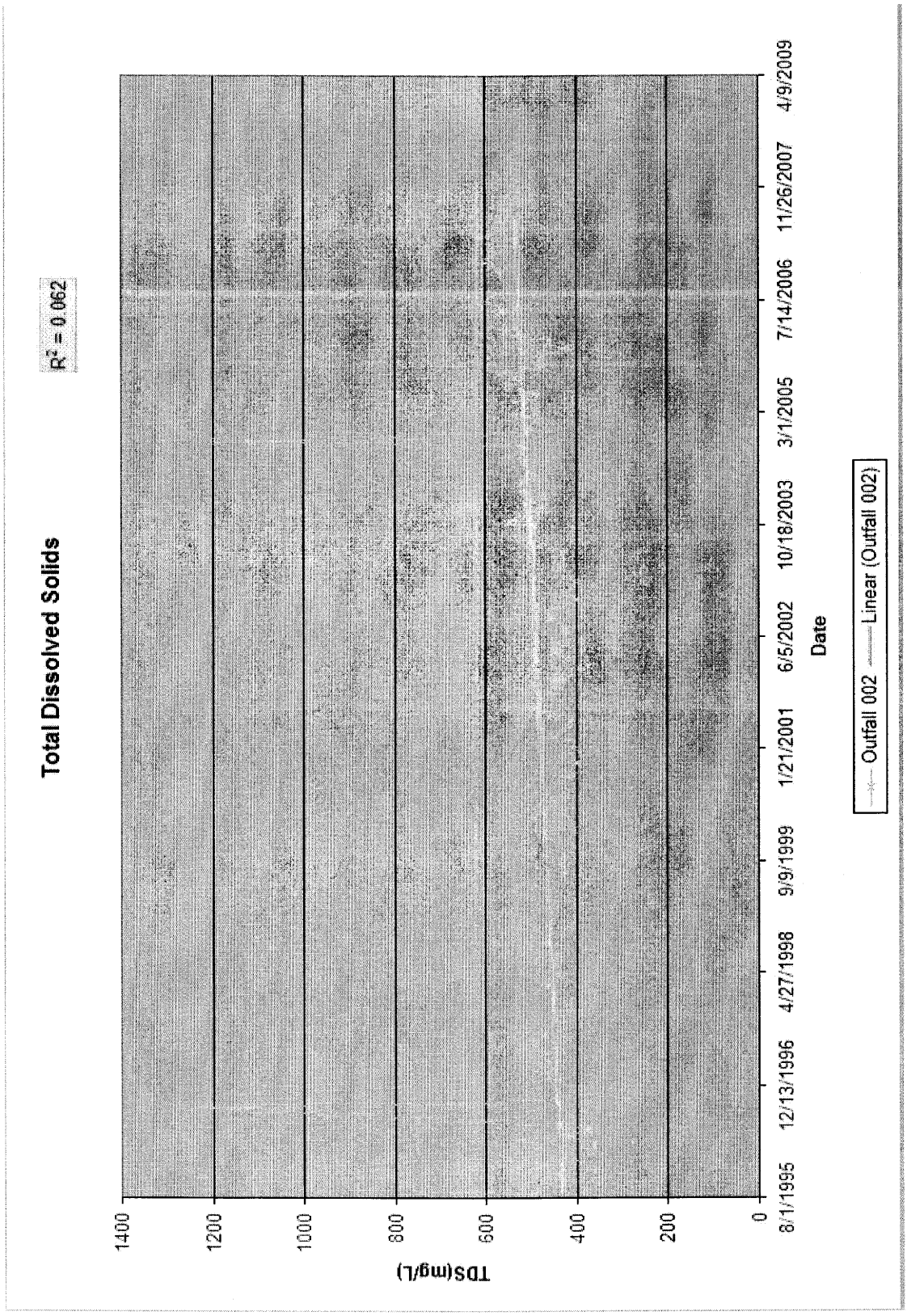

Bicarbonate as $CaCO_3$
$R^2$ = 0.4391
Bicarb (mg/L)
400
350
300
250
200
150
100
50
0
2/17/2005
5/28/2005
9/5/2005
12/14/2005
3/24/2006
7/2/2006
10/10/2006
1/18/2007
4/28/2007
Date
SP-79
Linear (SP-79)

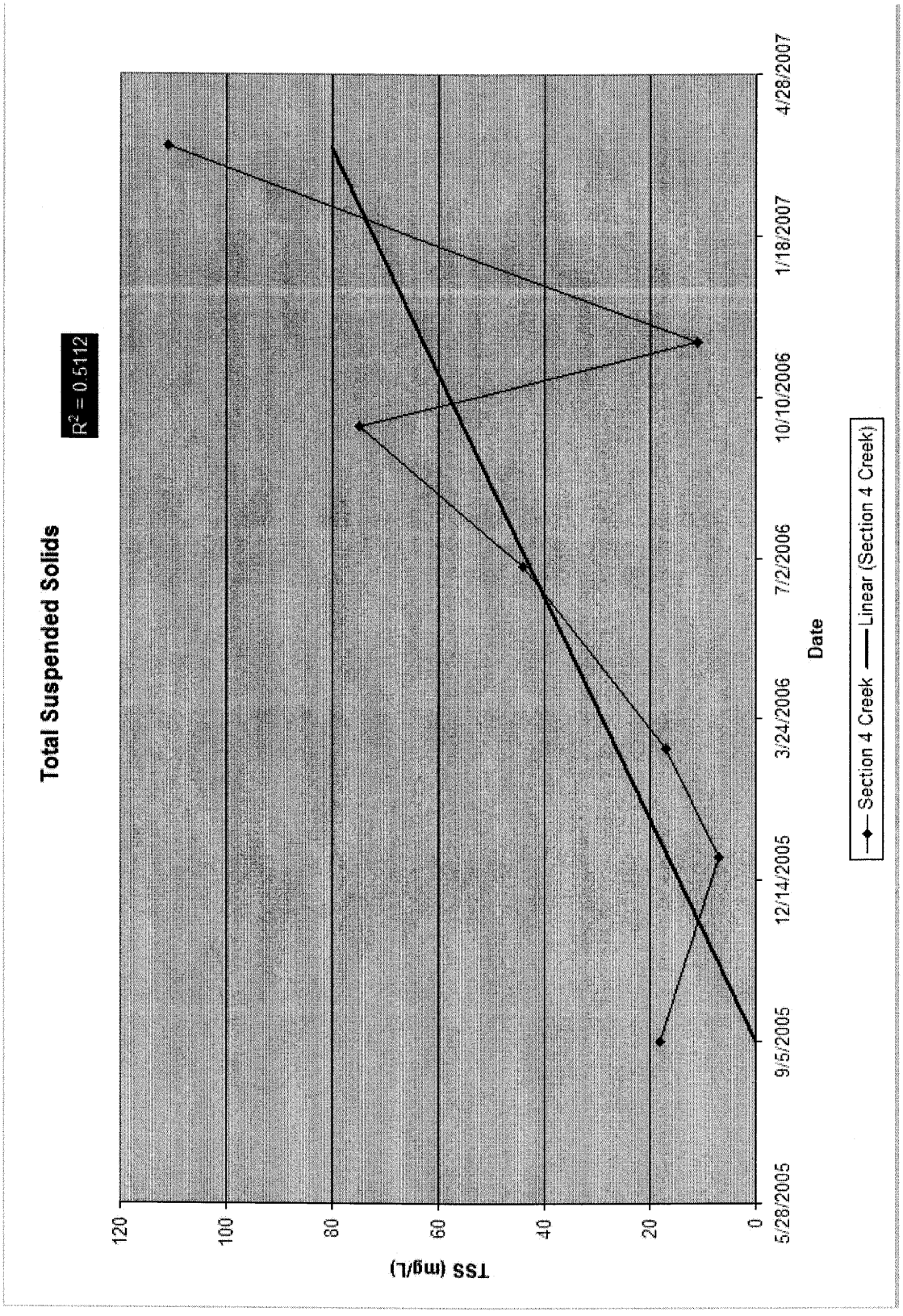

Carbonate as $CaCO_3$
$R^2 = 0.029$
Carbonate (mg/L)
30
25
20
15
10
5
0
10/28/1995
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
1/14/2004
5/28/2005
10/10/2006
2/22/2008
Date
BCF
Linear (BCF)


Dissolved Magnesium
$R^2$ = 0.321
D-Mg (mg/L)
0
10
20
30
40
50
60
70
80
5/28/2005
9/5/2005
12/14/2005
3/24/2006
7/2/2006
10/10/2006
1/18/2007
4/28/2007
Date
Section 4 Creek
Linear (Section 4 Creek)


Specific Conductivity
$R^2$ = 0.321
Sp. Cond. (µmhos/cm)
1200
1000
800
600
400
200
0
6/15/1994
10/28/1995
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
Date
Outfall 002
Linear (Outfall 002)


Total Hardness
R² = 0.2009
Hardness (mg/L)
510
500
490
480
470
460
450
440
430
420
8/1/2005
11/9/2005
2/17/2006
5/28/2006
9/5/2006
12/14/2006
3/24/2007
7/2/2007
Date
Section 4 Creek
Linear (Section 4 Creek)


Total Dissolved Solids
R² = 0.062
TDS(mg/L)
1400
1200
1000
800
600
400
200
0
8/1/1995
12/13/1996
4/27/1998
9/9/1999
1/21/2001
6/5/2002
10/18/2003
3/1/2005
7/14/2006
11/26/2007
4/9/2009
Date
Outfall 002
Linear (Outfall 002)


Total Suspended Solids
$R^2$ = 0.5112
TSS (mg/L)
120
100
80
60
40
20
0
5/28/2005
9/5/2005
12/14/2005
3/24/2006
7/2/2006
10/10/2006
1/18/2007
4/28/2007
Date
Section 4 Creek
Linear (Section 4 Creek)